

# Undergraduate Engineering Summer School

# FLOW

*Grand Industrial Challenges in France*

May 19<sup>th</sup> – June 13<sup>th</sup> 2025

## PROVISIONAL CURRICULUM



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## CONTENT

Scientific courses (lectures + scientific visit) to choose from:

- Sustainable Energy & Materials (SEM) ----- p 3
- Data & Information Processing (DIP)----- p 7

Workshop on sustainable development----- p 10

French Language and culture, Interculturality ----- p 11

*1 ECTS = 15 - 20 hours of workload completed by the student (lectures, labs, projects, personal work...)/ 2 European Credits (ECTS) are equivalent to American Credit*

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# SCIENTIFIC COURSES

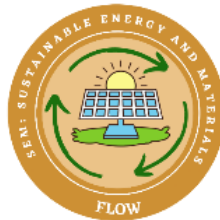
## 60 h – 4 ECTS

### SUSTAINABLE ENERGY & MATERIALS (SEM)

*Sustainable energy*

*Materials for sustainable development*

*Sustainable buildings*



**UTSA**

The University of Texas  
at San Antonio™

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## SUSTAINABLE ENERGY

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Course instructors: F. Henn, T. Talbert, R. Le Parc, N. Louvain

Prerequisite: basic scientific knowledge

Course span: 9h lecture + 3h lab visit

Provided material: non

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Software: none

Course content:

This course aims at presenting three different energetic solutions developed in the south of France. The context and energetical issues will be introduced followed as well as the concept of energy and its emergence throughout history, some recalls of the main principles...Then different energy conversions will be developed through the eyes of material engineers.

The first topic is related to batteries (2): How does it work? What are the main electrical features of a battery depending on the couple used, e.g. Lead/acid, Li-ion, Fuel Cells? What is the link between the “inside” functioning and the “outside” (black box) performances? and finally what are the main industrial development of batteries in the framework of the sustainable energy “revolution” imposed by the climate change.

Other solutions for energy storage will be evoked, commonly named ‘electro-fuels’, based on either Hydrogen (best candidate but suffers up to now from some drawbacks such as its storage capacity and safety) or Ammonia (NH<sub>3</sub>), showing some advantages on hydrogen.

The second part will be dedicated to solar photovoltaic and thermal power starting with the principle of the thermodynamic conversion of concentrated solar energy. The challenges related to thermal storage, and night power release will also be discussed. We will present the Different commercial solar thermal power plants in the world and the vision for the future... In order to better understand the Photovoltaic solution, Photovoltaic effect will be explained, the interest for concentrated photovoltaic solution will be detailed. Finally, we will evoke the photovoltaic energy distribution within the French electricity grid and the management of PV power plant.

Eventually, the nuclear energy will be presented including the materials involved in the nuclear, the radiation damages, the security issues, the recycling and storage of nuclear wastes.

Assessment: Multiple-choice questions, report

*Reference sources:*

- (1) *An Introduction to Nuclear Materials: Fundamentals and Applications* by K. Linga Murty, Indrajit Charit, Publisher: Wiley-VCH; 1 edition (January 29, 2013)
- (2) *Electrochemical Energy Storage (Anglais) Broché* – 3 mars 2015 by Jean-Marie Tarasco, Patrice Simon, ISTE Ltd. (3 mars 2015)
- (3) *Welding Level 1 Trainee Guide, 3e, Paperback* by NCEER

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## MATERIALS FOR SUSTAINABLE DEVELOPMENT

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Course instructors: J.L. Bantignies and R. Metz

Prerequisite: No prerequisite.

Course span: 4,5h lectures + 9h practical works & projects

Provided material: Computers Softwares: LCA SIMAPR02

Course content:

Concept, norms and practical tools

The objective of this course is to introduce engineering methodology for Eco design. The industrial LCA SIMAPR02 software will be used for practical lessons and project.

Materials for sustainable development: context and history

Life cycle assessment method: life cycle and Emission/Extraction inventory Life cycle assessment method: Impact factor calculation

LCA practical lessons: Inventory, Environmental Impact and Case study LCA project

Assessment: Multiple-choice questions, Project

Reference sources:

- *“Environmental Life Cycle Assessment” 1st Edition, Olivier Jolliet et al. CRC Press (2015) - 302 Pages, ISBN 9781439887660 - CAT# K14053*
- <https://www.pre-sustainability.com/download/SimaPro8IntroductionToLCA.pdf>

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## SUSTAINABLE BUILDINGS

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### *SUSTAINABLE BUILDINGS 1*

Course instructors: W.Ghannoum

Prerequisite:

Course span: 12 hours of lectures/tutorials + 8h visit

Provided material:

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Software:

Course content:

This course will be dedicated to sustainable materials in construction: mainly concrete, steel, and fibre-reinforced plastic. Exercises will lead the students to calculate energy and CO2 costs for various designs of a simple structure and discuss benefits and costs. Eventually a cost benefit analysis of building a bridge will be led. The courses will be completed by a visit of a site illustrating Material/building issues.

Assessments: Multiple-choice questions, in-class exam or report

## *SUSTAINABLE BUILDINGS 2*

Course instructors: D. Cervellin, C. Reynaud, Y. Duhamel

Prerequisite: none

Course span: 1 hours of lectures + 12h lab

Provided material: welding equipment

Software: DAO software

Course content:

Welding plays a critical role in all industrial sectors, particularly in energy and materials plants. This course provides an introduction to the science and technologies of welding.

Students will also gain access to PRO3D, the technological platform at the University of Montpellier dedicated to prototyping and additive manufacturing (including 3D printing with polymers, resins, and metals). Through hands-on experience in developing a prototype, students will familiarize themselves with additive manufacturing techniques, complementing the theoretical knowledge acquired during the SEM session.

Assessments: none

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# DATA & INFORMATION PROCESSING

*Data science & artificial intelligence*

*Design & development of mobile apps for  
IOS/IPADOS/MACOS*



**Strathmore**  
UNIVERSITY

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## DATA SCIENCE AND ARTIFICIAL INTELLIGENCE

Dates: May 19<sup>th</sup> - May 30<sup>th</sup> 2025

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### *DATA MINING AND MACHINE LEARNING*

Course instructors: A. Laurent + other instructors

Prerequisite: No prerequisite. Basic notions of SQL and Python programming are a plus

Course span: 24 hours of lectures and hands-on labs delivered over a week

Provided material: Computers Softwares: Weka, Python, PostgreSQL, SQL, Neo4j

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Course content: This course is an introduction to data management, data mining and artificial intelligence. It presents the main methods of data management (SQL, OLAP/reporting, graph databases, ...), data mining and machine learning from the computer science perspective: supervised and unsupervised algorithms, deep learning, generative AI and pattern mining. The course also focuses on evaluation methods and applications to health and environment. You will explore several datasets and methods through a hands-on lab.

Assesment: Surveys of the labs

## *CLLOUD, IOT & AI PROTOTYPI*

Course instructors: IBM

Prerequisite: No prerequisite.

Course span: 6 hours of hands-on labs

Provided material:

Course content: Discover a cloud computing platform (IBM Cloud) and measure the interest proposed by this large catalog of services around the Internet of Things (IoT), Artificial Intelligence (IA) and data management, and quickly develop IoT solutions, with data collection and augmentation using AI services (natural language processing, computer vision, etc.). A lab will then allow you to build an IoT data processing chain through Node-Red. This block-based graphical coding interface will allow you to acquire, store, monitor and explore data without coding.

Assessment: Screenshots of the lab key step

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## DESIGN AND DEVELOPMENT OF MOBILE APPS FOR IOS/IPADOS/MACOS

Dates: June 2<sup>nd</sup> – June 13<sup>th</sup> 2025

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Course instructors: C. Fiorio, V. Berry, O. De Jonckere

Prerequisite: skills in Object-Oriented Programming, practice of basic design patterns

Course span: 30 hours of lectures and hands-on labs delivered over a week

Provided material: iPads / in room Mac Book Pro laptops

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Software: Swift playground, Xcode, Git, Firestore

Course content:

- Intro to iOS development & useful design patterns
- Swift as a programming language (syntax, specificities, tool chain)
- MVVM UI conception pattern (separation of concern, delegation, observer pattern, ...)
- SwiftUI framework for modeling UIs in a declarative way
- Designing views with graphical widgets
- Navigating between views
- Maintaining a single source of truth
- Ensuring widgets reactive behavior
- Storing and retrieving data from the web:
- Coding/Decoding json content
- Communicating with an APIsDAO & DTO design patterns
- Communicating with a remote database

Optional: depending on the student's progression speed, the MVI UI conception pattern will be presented and practiced

- Mode of Delivery: Project-based approach
- Expected Learning Outcomes
- Project on building an iOS mobile app
- Short lectures interleaved with lab sessions dedicated to the project
- At the end of this course, the student will be able to:
- Design patterns, frameworks and their practice (Delegator / Delegate, Observer/Observable, MVVM,MVI, ...)
- Employ the Xcode IDE to implement a mobile app for the Apple eco-system, while interacting with other programmers
- Employ various components of the SwiftUI and Combine frameworks to maintain data consistency and ensure reactivity of UI components and views in a mobile app
- Design and implement a multi-view mobile app for iOS,iPadOS & MacOS platforms, as a working solution to a real-world problem.

# WORKSHOPS ON SUSTAINABILITY

## 16 h – 1 ECTS



12h face to face + 4h individual work

This workshop will serve as a forum for debate on key issues related to the ecological transition, including the Anthropocene, resource management, renewable energies, and the 17 Sustainable Development Goals (SDGs) of the United Nations. The discussion will be enriched by contributions from experts, exercises, games, and collaborative work in multidisciplinary and international teams.

Assessment: Multiple-choice question or oral presentation

Reference source:

- <https://www.un.org/development/desa/disabilities/envision2030.html>

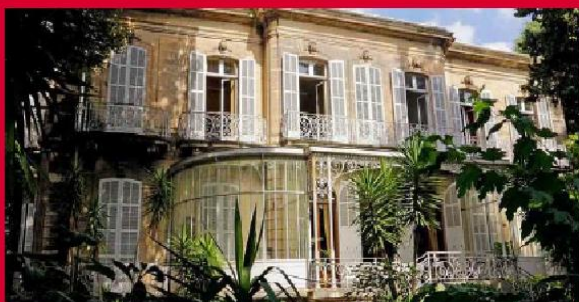
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# FRENCH LANGUAGE & CULTURE, INTERCULTURALITY 24 h – 1 ECTS



Alliance Française  
Montpellier



## Your intensive French course

Learn French at Polytech Montpellier: discover the French language and culture through interactive and intercultural courses.

- > 4 lessons of 1 hour per week, i.e. 4 hours per week for 4 weeks. Among these 4 hours of lessons, 1 hour will be dedicated to the intercultural approach in the professional environment.
- > A communicative and qualitative pedagogy : a living approach to the French language. Practice the language in interaction in everyday situations and develop your skills thanks to the expertise of the Alliance Française!



- > Passionate teachers and fun activities that will make you love learning the French language.
- > Certificate of completion of internship recognized by the international network of Alliances Françaises.

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Because at the Alliance Française Montpellier we are committed to offering you a rich and unique cultural program, the program presented below includes all the specific requests and desires indicated beforehand by the representatives of the stay.

### Example of Activities

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Full-day tour with guide: **discovering Carcassonne**

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Full-day tour with guide: **visit of the Larzac, the Millau Viaduct and the town of Roquefort**

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Full-day tour with guide: **Nîmes, its arena and the Pont du Gard**

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**IF YOU HAVE ANY QUESTION  
PLEASE CONTACT**

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<https://www.polytech.umontpellier.fr/international/summer-school>

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